The Economic and Social Significance of RCA Regional Co-operative Projects

by E.E. Fowler

The Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (RCA) is an established and valuable instrument between the International Atomic Energy Agency (IAEA) and Member States in South Asia, South-east Asia and the Pacific or Far East for assisting in the transfer of modern technology to areas having economic and social importance to the region. The purpose of this review is to identify on-going or planned work which is designed to help achieve this important goal.

The structure and operational aspects of the RCA were the subject of an article in the August 1978 IAEA Bulletin Ref [1] and will not be discussed here. Table 1 lists currently approved RCA Regional Co-operative Research Projects. The RCA aims to direct its technological efforts to areas of highest regional interests. These are food and agriculture, health care, industrial development, and environmental protection along with upgrading the infrastructure in the region to keep pace with technological advancements.

INCREASING FOOD SUPPLIES

Food and the feeding of people are major world problems which adversely affect countries in the RCA region. Today, there are 700 million people in developing countries with insufficient daily food supplies. One hundred million children are always hungry. More than 15 million of them die each year from a combination of malnutrition and infection. Today, there are 4 billion people in the world. Estimates by the World Bank indicate that by the year 2000, this population will have increased to about 6.3 billion. It is projected that the world's population will stabilize at about 11 billion – nearly three times today's number. These data provide some idea of the dimensions of the world food problem and its implications for the region. The resolution of the problem, if indeed it can be resolved, calls for massive initiatives on many fronts.

Nuclear technology plays a small but perhaps important role in the battle to feed hungry people. Technological initiatives now underway within RCA, if successfully reduced to practice, can contribute to increasing food supplies, and prevent large food losses through spoilage and destruction by pests. These efforts include: (a) the use of ionizing radiation as an effective, safe new food processing method to supplement or replace thermally processed or chemically treated foods; (b) radiation-induced mutations to yield new strains of agricultural crops such as cereals and legun.es having higher productivity and being more

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resistant to diseases; and (c) the improvement, through the use of nuclear technology, of the productivity of domestic animals, such as buffalo, to yield increased milk production, meat supply and draught power.

The application of ionizing radiation as a food processing method involves using sterilizing doses for long term, unrefrigerated storage of food products, substerilizing doses of radiation to provide for extension of shelf life and marketing time for fresh foods, and lastly, the use of radiation in doses of tens of kilorads for sprout inhibition in foods such as potatoes and onions and for control of pests causing damage to stored foodstuffs such as grain and dried fish. The efforts within RCA involve the last two of these methods.

In South-east Asian countries, rice is produced in large quantities (approximately 150 million tons of paddy annually at a cost of some 20 billion US dollars) and is the staple food for the population of the region. Insect infestation is recognized as a major factor in the losses of rice especially after milling. Next to rice, fish and fish products are of greatest importance in providing necessary protein supply (up to 20 percent of the total protein consumption) and therefore adequate diets to people in Asia and the Pacific.

The total catch of fish in South and South-east Asian countries is estimated to be more than 8 million tons per year having a value greater than 1.2 billion US dollars. These numbers are significantly increased if one adds the catch and value of Pacific RCA countries such as Japan.

In view of the very high spoilage of fish and fish products and the loss of grain products through insect destruction in these countries even small reductions will importantly increase the availability of essential nutritive foodstuffs and contribute significantly to the improvement of the socio-economic situation of the region's population.

Food processing technology using ionizing radiation has been demonstrated to be effective in insect disinfestation of grains, fresh fruits and dried fish and in extending the marketing time of fresh foodstuffs such as fish and fish products. Laboratory-scale research has been carried out on this food processing method in many countries of the world and in most if not all countries of the RCA. However, only a few RCA countries have capabilities for developing the next stage of the technology leading to commercialization. A requirement now exists to carry out pilot-scale work for process development, consumer testing and market studies. At present, the single RCA country commercially marketing a food product that is processed using radiation is Japan. In this case, radiation is applied to potatoes for sprout inhibition.

Current RCA consideration may result in the establishment of a regional pilot-scale capability leading to commercial application of this new food processing method. The IAEA in conjunction with RCA Member States, Bangladesh, India, Indonesia, Japan, Republic of Korea, Malaysia, Pakistan, Philippines, Sri Lanka and Thailand, is now taking specific steps to bring about the introduction of this food processing technology which can yield major gains such as increased food supplies, reduced high losses and improvement in the processing, distribution and marketing chain. The cumulative effect of these gains will be of high economic value and more importantly, social impact, in an area of greatest humanitarian benefit – the increased food supply and improved nutrition for people in this region of the world.

In other areas of food production, RCA is contributing towards improving the level of plant protein, milk and meat supply through regional co-operative research projects. These efforts

Table 1. RCA Regional co-operative research projects

1. Regional Project on the Use of Nuclear Techniques in Improving Buffalo Production

   Participating Countries

   Australia
   Bangladesh
   India
   Indonesia
   Malaysia
   Philippines
   Sri Lanka
   Thailand

2. Regional Project on the Use of Induced Mutations for the Improvement of Grain Legume Production

   Participating Countries

   Bangladesh
   India
   Indonesia
   Republic of Korea
   Malaysia
   Pakistan
   Philippines
   Sri Lanka
   Thailand

3. Regional Project on Radiation Preservation of Dried Fish Indigenous to Asia

   Participating Countries

   Bangladesh
   India
   Indonesia
   Pakistan
   Philippines
   Thailand

4. Co-ordinated Research Programme on Health Related Environmental Research Using Nuclear Techniques

   Participating Countries

   India
   Indonesia
   Republic of Korea
   Pakistan
   Philippines
   Thailand

5. Co-ordinated Research Programme on Neutron Scattering Techniques in Applied Research

   Participating Countries

   India
   Indonesia
   Republic of Korea
   Philippines

Table 1 (continued)

6. Co-ordinated Research Programme on Maintenance of Nuclear Instruments

Participating Countries

Bangladesh*	Pakistan*
Indonesia*	Philippines
Republic of Korea	Sri Lanka
Malaysia	Thailand

7. Co-ordinated Research Programme on Isotope Applications to Hydrology and Sedimentology

Participating Countries

Bangladesh	Philippines
Indonesia	Singapore
Republic of Korea	Sri Lanka
Malaysia	Thailand

* Have indicated interest in participation.

are directed toward the use of induced mutations to provide an improved germ plasm base for grain legume breeding and the use of nuclear techniques in improving domestic buffalo production in South-east Asia.

Grain legumes have traditionally afforded a considerable portion of the protein nutrition for the people of the region. Increasing the production of grain legumes can provide a means for significantly improving the level of this essential dietary component in the future. Grain legumes offer major advantages as food materials. Their seeds contain 25 percent or more protein than cereals. Furthermore, the essential amino acid content of the protein in grain legumes is higher than in cereal grains which cannot sufficiently provide this dietary need. Therefore, grain legumes are a valuable supplement to the normal staple cereal diet to serve the population in South-east Asia.

Shortages and increasingly higher prices for nitrogen fertilizer have accented a further benefit of legume production. These plants, with proper soil and crop management, are capable of meeting much of their nitrogen requirement through microbial symbiosis, thereby minimizing the need for costly nitrogen fertilizer. This is especially true when cropping is equitably divided between the higher yielding cereals and the grain legumes. The great success of high yielding cereal varieties during the past decade actually caused a diversion of land from legume to cereal production in many countries. In view of the high nitrogen fertilizer requirement for increased yields of cereals, present circumstances indicate the need for a reversal of that trend.

Much research needs to be done to improve the productivity of legumes in the region. The introduction of nuclear techniques can make a significant contribution towards increasing the production of grain legumes in two important ways, namely (a) in helping improve crop management practices, and (b) in developing plant varieties that meet local requirements (disease resistance, climatic and soil adaptability, consumer acceptance, etc.) and produce higher yields than currently obtainable. Present work with RCA Member States in Bangladesh, India, Indonesia, Republic of Korea, Malaysia, Pakistan, Philippines, Sri Lanka and Thailand, is directed to the second of these activities.

Through the RCA, a pooling of national resources and a co-ordinated distribution of work on the various grain legumes of importance to countries in the region will contribute significantly towards improving their productivity. The regional co-operative research project now in progress is designed to achieve realization of improved plant varieties at lower cost and relatively sooner through effective co-operation among Member States participating.

Another RCA move important to food production and other regional interest is work in progress to improve buffalo production. The world population of buffaloes is about 140 million and over 95 million of these are located in the Asian region. India has about 60 million, Pakistan 10 million, Thailand 6 million and the Philippines 5 million. Buffaloes are important to the region for milk production, draught power and, increasingly, as a source of meat.

In India, buffaloes contribute more than 16 million of the 24 million tons of milk produced annually. It has been estimated that the buffalo is about four times more productive in terms of milk yield than the average cow. The significance of the buffalo as a work animal can be gauged from its role in the rice growing areas of South-east Asia. Subsistence farmers cultivate 1–4 hectares of crop land and raise one to several head of buffalo for cultivation and transport. When it has finished its working life, the buffalo becomes an important source of meat.

The unique role of the buffalo in agricultural systems in Asia has been recognized in recent years and increased research into methods of improving its production have been actively promoted by many national and international programmes. The FAO and UNDP have been at the forefront in advancing these co-ordinated programmes. The Animal Production and Health Commission for Asia (APHCA) is playing a major role in the Asian region. Under RCA a co-operative research project is in progress involving participation by Australia, Bangladesh, India, Indonesia, the Philippines, Sri Lanka and Thailand. Malaysia has also indicated its interest to participate. This research effort along with other national and international efforts is focused on improvement of buffalo production and on the importance of reproduction, nutrition and disease control in achieving the desired goals.

In each of these fields, isotope and nuclear techniques are important to increased understanding. In reproduction, radio-immunoassay techniques are being used to measure accurately homonal changes in the animal which indicate reproductive status and performance. In nutrition, these techniques are used to determine the effectiveness of rumen by-pass technology for high quality supplements and to measure the efficiency of utilization of non-protein nitrogen supplements in the rumen. In the case of parasitic diseases, isotopes are used to monitor the effects of injections on performance parameters. Radiation can be used in the production of attenuated vaccines. Both of these applications can lead to improved management procedures for parasitic control.

APPLICATION OF NUCLEAR TECHNIQUES TO HEALTH CARE

In the area of health care, Member States to RCA are increasingly interested in the use of large radiation sources for medical supply sterilization. Large-scale UDNP demonstration plants have been placed in operation in India and the Republic of Korea. Another facility has been built in Indonesia for commercial medical supply sterilization purposes. The advantages of radiation over other conventional techniques of sterilization are well recognized and accepted. The process provides greater reliability, it can be applied to thermoplastics used for disposable medical products and it assists in the overall improvement in medical care.

The introduction of this technology in developing countries is of special socio-economic significance.

With conventional techniques, in particular, plants using autoclaves and ethylene oxide, highly trained technical staff is required for routine operation and maintenance problems are many. Because of the faulty operation of this equipment in many hospitals and industries in developing countries, the sterilization achieved is less than adequate which results in serious cross-infection. This is hazardous to human life and expensive from the point of view of hospital beds occupied. For these reasons, the IAEA, in conjuntion with Member States, has supported work to increase the use of radiation sterilization.

The introduction of radiation sterilized medical products in developing countries can also help to raise the level of health care in the rural sector, where modern conventional facilities for sterilization are not available. Thus, for instance, ready-to-use sterile kits for surgical procedures and for first aid treatment of wounds or for family planning procedures have been introduced for the first time on the Indian market. These products have been sterilized using radiation.

The IAEA is now initiating steps to assist RCA Member States in realizing broader commercial use of radiation sterilization of medical products in a proposed UNDP large-scale industrial demonstration project. The plan envisions use of the Cobalt-60 plant at the Korean Atomic Energy Research Institute as a regional centre. Collaborative regional work will be carried out to develop necessary infrastructures with the required trained manpower for full commercial acceptance of the technology by industries in Bangladesh, Philippines and Thailand. It is also proposed that the UNDP Radiation Demonstration Facility at the Bhabha Atomic Research Centre, Trombay, India co-operate in this effort.

RADIATION AND RADIOISOTOPES IN INDUSTRY

The UNDP Regional Industrial Project referenced above is a broadly designed plan to:

(1) Create economic and social gains through the expanded use of modern nuclear technology in industries in RCA Member States,
(2) Improve the competitiveness of manufactured products in world markets through better quality control, higher productivity and lower costs, and
(3) Effect savings in raw materials and energy in high consumption industries.

The Project is expected to achieve social gains in the following manner:
(a) It will give support to the country's infrastructure, and contribute to the development of trained manpower.
(b) It will promote health care and enable reduction in environmental pollution through some of the proposed projects.

(c) It will help towards rural development through improvements of agro-based industries.
(d) It will help to create greater employment and improve productivity.
(e) It will promote, in an important area, regional co-operation among the RCA Member States and, thus, take an important step towards regional self-reliance.

The developing countries of Asia and the Pacific have made constant efforts to convert their economies from rural to industrial economies, but have encountered obstacles in achieving these aims. These include lack of adequate infrastructure, the absence of trained manpower and insufficient management skills for development of an indigenous technology base and for the transfer of technology from advanced countries.

While the level and diversity of industrialization in individual countries in the region vary considerably, most Member States party to RCA have established industries which can accept selected technologies with expected benefits. Using as a reference the United Nations Classification of all Economic Activities, nearly all industrial groups are present in the region. These include mining, textiles, synthetic fabrics, rubber, paper and paper products, chemicals, petrochemicals, metals and electronics. Coupled with these industries are rapidly growing construction programmes including buildings, roads, as well as waterways and harbours critical to increased commerce. Representatives of RCA Member States have determined that through the end of this century high priority must be given to the introduction of modern technology in regional industries

A key to extending the use of industrial isotope and radiation technology so that full benefits are achieved to yield both near term and long term value is the requirement to create a critical force through regional co-operation which is greater than that existing in most of the countries individually. The RCA provides the vehicle for achieving this goal with its complement of highly industrialized States and advanced developing countries. Early identification and commitment of national institutes and laboratories for use as regional centres of excellence in major areas of isotope and radiation applications must be achieved. Coupled with the large-scale technology transfer and demonstration programme envisaged under this proposed regional UNDP Project, the necessary capability exists for significant movement toward the goal of integration of modern technology and practice into industries of the region with concomitant economic and social gains.

Isotopes and radiation technology have been reduced to practice over the past 30 years by industrialized nations with well-established and demonstrated economic benefits. Most industrial applications of isotope and radiation technology are related to process measurement, quality control, composition analysis, as well as new product manufacture. Technology transfer can be made to various regional industries for such purposes as economizing in raw materials consumption, energy conservation, environmental protection, control of product quality, and for safety inspection. In Japan it has been estimated that the industrial applications of isotope technology makes a tangible contribution to the economy of this country of at least US $1 billion per year. A comparable saving is being realized in most other industrialized nations of the world but at a reduced level. The need and the opportunity exist for industries within developing RCA Member States to achieve benefits yielding important economic and social gains.

Reference

[1] The Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology, E E Fowler, IAEA Bulletin, **20**, 4, 18–22, (August 1978).